PATENT ABSTRACTS OF JAPAN

(11)Publication number : **07-081430**
(43)Date of publication of application : **28.03.1995**

(51)Int.Cl. **B60K 1/00**

(21)Application number : **05-253619**
(22)Date of filing : **17.09.1993**

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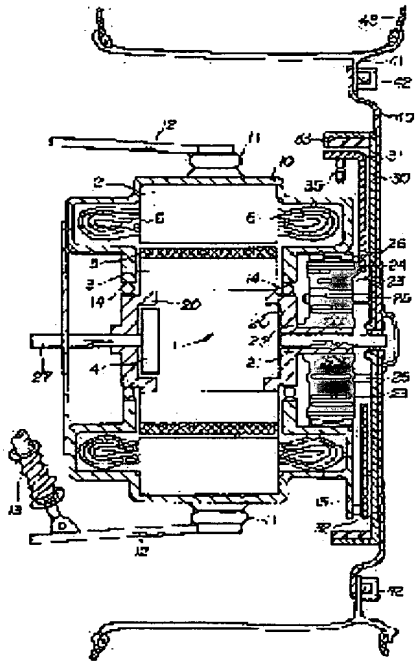
(54) DRIVE DEVICE OF ELECTRIC VEHICLE

(57)Abstract:
PURPOSE: To provide a drive device of an electric vehicle of which the weight is light although a speed reducing mechanism is provided between an electric motor and wheels, and the whole efficiency is excellent.
CONSTITUTION: The hub 40 of a wheel is driven by an inner rotor type direct current motor 1 through a speed reducing mechanism. The speed reducing mechanism is constituted of a sun gear 22 fitted to the rotary shaft 21 of the inner rotor type direct current motor 1, planetary gears 23, 23,... engaged with the fun gear 22, and a ring gear 24 engaged with the planetary gears 23, 23,..., carries 25, 25,... of the planetary gears 23, 23,... are combined with a brake drum 30, and the hub 40 of the wheel is directly coupled with the brake drum.



LEGAL STATUS

[Date of request for examination]	17.09.1993
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2545733
[Date of registration]	08.08.1996
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	10.11.2000

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CLAIMS

[Claim(s)]
[Claim 1] It is the driving gear of the electric vehicle characterized by being the driving gear of the electric vehicle which a wheel drives through a moderation device by the electric motor, and linking the hub of a wheel with said body of revolution for brakes directly while said moderation device consists of the sun gear attached in the revolving shaft of an electric motor, planetary gear which gear with this sun gear, and a ring wheel with which these planetary gear gear and the output shaft of said planetary gear or a ring wheel is combined with the mechanical body of revolution for brakes.
[Claim 2] An electric motor according to claim 1 is a driving gear of an electric vehicle which is the inner rotor mold of a brush loess direct-current motor or an induction motor.
[Claim 3] Quiescence members, such as an anchor pin of the brake shoe which collaborates with the body of revolution for brakes according to claim 1 or 2, or the caliper body of a disk brake, are driving gears of an electric vehicle connected to the outer frame to which the armature of an electric motor is being fixed.
[Claim 4] The outer frame of the armature of an electric motor given in one 1st term of claims 1-3 is a driving gear of an electric vehicle attached in the suspension arm through the swivel joint.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the driving gear of the electric vehicle which a wheel drives through a moderation device by the electric motor.
[0002]
[Description of the Prior Art] The driving gear of the electric vehicle equipped with the electric motor instead of the internal combustion engine is variously proposed from the former. For example, the in wheel motor drive method which included the electric motor in the interior of a wheel, The driving gear which prepared the automatic transmission between the revolving shaft of an electric motor, and the revolving shaft of a car in this in wheel motor drive method, The DC-motor mold direct drive method which linked the rim of a wheel with Rota of the DC motor of a winding-type outer rotor mold directly, this DC-motor mold direct drive method and abbreviation -- it has the same structure and the so-called brush loess direct-current motor mold direct drive method whose motor is a brush loess direct-current motor is proposed.
[0003]
[Problem(s) to be Solved by the Invention] An electric vehicle can be driven with any above-mentioned drive method. The advantage of especially an in wheel drive method being able to extend the effective space by the side of a car body, and also being able to make a body weight comparatively light, since the drive system is contained in the wheel is accepted. Moreover, according to the direct drive method, a body weight can also be made small. However, there are also various troubles in the conventional drive method. For example, even if driving force with the sufficient direct drive method which drives a direct wheel by electric motor like the DC-motor mold direct drive method by the in wheel motor drive method is obtained, it cannot make high energy efficiency of the motor at the time of acceleration and regeneration, but has the fault [halt / start and] that it is inelastic in the mileage per 1 charge in frequently required city area transit. On the other hand, if an automatic transmission is prepared between the revolving shaft of an electric motor, and the revolving shaft of a car, although the energy efficiency of the motor at the time of ** and moderation becomes good, its weight of an automatic transmission will be large, and the effectiveness of the whole driving gear will worsen. Therefore, this invention aims at offering the driving gear of the whole efficient electric vehicle lightweight, although the moderation device is established between the electric motor and the wheel.
[0004]
[Means for Solving the Problem] In order that this invention may attain the above-mentioned purpose, it is the driving gear of the electric vehicle which a wheel drives through a moderation device by the electric motor, said moderation device consists of the sun gear attached in the revolving shaft of an electric motor, planetary gear which gear with this sun gear, and a ring wheel with which these planetary gear gear, and while the output shaft of said planetary gear or a ring wheel is combined with the body of revolution for brakes, the hub of a wheel is directly linked with said body of revolution for brakes. The electric motor according to claim 1 of invention according to claim 2 is the inner rotor mold of a brush loess direct-current motor or an induction motor. Invention according to claim 3 Quiescence members, such as an anchor pin of the brake shoe which collaborates with the body of revolution for brakes according to claim 1 or 2, or the caliper body of a disk brake It connects with the outer frame to which the armature of an electric motor is being fixed, and the outer frame of the armature of an electric motor given in one 1st term of claims 1-3 is attached in the suspension arm for invention according to claim 4 through the swivel joint.
[0005]
[Function] For example, an accelerator pedal is stepped on. If it does so, in proportion to the broken-in

amount, it will energize in the coil of a motor. If it does so, the revolving shaft of a motor will rotate and a sun gear will rotate. Since a sun gear rotates. The planetary gear which have geared with the sun gear revolve around the sun with the reduction gear ratio which was able to determine the surroundings of a sun gear, gearing with a ring wheel 24. Therefore, the rotation drive of the body of revolution for brakes is carried out with the output shaft of planetary gear. It rotates gradually and an electric vehicle also leaves slowly the hub of the wheel of the body of revolution for brakes, and one. In proportion to the broken-in amount, the rotational frequency of a revolving shaft goes up and is accelerated. If an accelerator pedal is detached and a brake pedal is stepped on, regenerative braking will start, a regeneration current will flow from a motor, and a recharge will be carried out to a cell. Braking starts mechanical-brake body of revolution in emergency.

[0006]

[Example] This invention can be carried out in various forms. For example, an induction motor can also be applied to an electric motor and it can also carry out by the brush loess direct-current motor. Moreover, a structurally simple drum brake, the high disk brake of braking effects, etc. are applied to a brake. The caliper body which a brake shoe is an anchor pin when carrying out with a drum brake, and holds friction putt when carrying out by disk brakes is fixed to the member by the side of a car body, respectively. In this example, these brake shoes and the caliper body are attached in the outer frame which is fixing the electric motor through direct or a stay. This invention is applicable to a passenger car and a truck. The electric vehicle of this example is also equipped with the accelerator pedal. And if this accelerator pedal is stepped on, in proportion to the broken-in amount, a current will flow on a motor. Moreover, it also has a brake pedal, if this brake pedal is stepped on, regenerative braking will start, and if it breaks in further, mechanical braking will start. However, the concrete example of these pedals is not shown in drawing. Moreover, it can also take from a ring wheel instead of taking out the output of a motor from planetary gear so that clearly from explanation of the following examples. However, this example is not shown in drawing, either. As mentioned above, although this invention can be carried out in various forms, drawing 1 explains the example which took out the output of the in wheel drive method motor which was equipped with the mechanical drum brake below, and built the brush loess direct-current motor into the interior of a wheel from planetary gear.

[0007] The driving gear concerning this example is equipped with the brush loess direct-current motor 1 as shown in drawing 1 . This brush loess direct-current motor 1 has a field 3 for the armature 2 which is a stator in the periphery section and the inside. The permanent magnet 5 currently formed from rare earth elements is being fixed to the field 3. Moreover, the brush loess direct-current motor 1 is equipped also with en KONDA 4. The location of a field 3 is detected by this en KONDA 4, and electric power is supplied by the coils 6 and 6 of an armature 2 by it according to that location. The armature 2 is being fixed in the outer frame 10. And the outer frame 10 is attached in suspension arms 12 and 12 through swivel joints 11 and 11. Since the edge of suspension arms 12 and 12 is supporting the car body, it is a holddown member. Therefore, it will be fixed and the field 3 which makes an armature 2 and a pair will rotate the armature 2 currently fixed in the outer frame 10. In addition, the sign 13 in drawing shows the shock absorber.

[0008] As an outer frame 10 wraps an armature 2 and coils 6 and 6, it is prolonged in the direction of a radius core, and the point is bearings 14 and 14. And the bearing of the rotation of the rotation member 20 which is supporting the field 3 is made free by these bearings 14 and 14. From one side of the rotation member 20, a revolving shaft 21 is prolonged in one and the sun gear 22 which constitutes the moderation device in this revolving shaft 21 is being fixed. The moderation device consists of two or more planetary gear 23 and 23 and -- which gear with the above-mentioned sun gear 22 to this sun gear 22, and revolve the surroundings of a sun gear 22 around the sun, and planetary gear 23 and 23 and the ring wheel 24 which has geared so that -- may revolve around the sun. And planetary gear 23 and 23, the carriers 25 and 25 of --, and -- are attached in this brake drum 30 so that the rotation drive of the brake drum 30 may be carried out. The ring wheel 24 is being fixed to the outer frame 10 through the friction member 26. Therefore, a brake drum 30 will be slowed down by revolution of planetary gear 23 and 23 and -- by carriers 25 and 25 and --, and a rotation drive will be carried out.

[0009] A brake drum 30 and the brake shoe 31 which makes a pair are formed inside a brake drum 30, and the edge is attached in the stay 15 of an outer frame 10 with the anchor pin 32. The diameter of this brake shoe 31 is expanded in the fluid cylinder 35, and it requires braking in contact with the brake putt 33 of a brake drum 30. The hub 40 of a wheel is being concentrically fixed to the brake drum 30. And the tire 40 is attached in the hub 40 of this wheel for the wheel 41 by bolts 42 and 42 and --. The tire 43 is attached in the periphery section of a wheel 41 as everyone knows.

[0010] Next, an operation of the above-mentioned example is explained. For example, an accelerator pedal is stepped on. If it does so, in proportion to the broken-in amount, a current will energize in the coils 6 and 6 of the brush loess direct-current motor 1. Since the bearing of the field 3 is carried out by bearings 14 and 14 to the outer frame 10 if it does so, it revolves around an axle 27. The revolving shaft 21 of this and one also revolves around an axle 27. Therefore, a sun gear 22 rotates. The planetary gear 23 and 23 which have geared with the sun gear 22, and -- revolve around the sun with the reduction gear ratio which was able to determine the surroundings of a ring wheel 24. Therefore, the rotation drive of the brake drum 30 is carried out by planetary gear 23 and 23, the carriers 25 and 25 of --, and --. It rotates gradually and an electric vehicle also leaves slowly the hub 40 of the wheel of a brake drum 30 and one. In proportion to the broken-in amount, the torque of a field 3 goes up and is accelerated. An accelerator pedal is detached, for example, a brake pedal is stepped on. If it does so, regenerative braking will start, according to the amount of treading in of a brake pedal, from the brush loess direct-current motor 1, a regeneration current flows and a recharge is carried out to a cell. Following on it, an electric vehicle slows down or stops. As it mentioned above below, it leaves, runs and stops. If a brake pedal is further broken into emergency, a compressed air will be supplied to the fluid cylinder 35, a brake shoe 31 will touch the brake putt 33, and mechanical braking will start.

[0011] According to this example, although various effectiveness is acquired, the effectiveness at the time of using a brush loess direct-current motor below is explained using a formula. Generally, effectiveness etaB of a brush loess direct-current motor is expressed with a degree type (1).

etaB=1/(1+AT/n+Bn0.6/T) (1)

In an upper type, the constant of the motor for which A depends on winding resistance and a torque constant, and B are the constants of the motor depending on the iron loss of a motor. Moreover, T is the torque of a motor and n is a rotational frequency. In addition, "AT/n" of the 2nd term of the denominator of a formula (1) is based on "Bn0.6/T" iron loss of the 3rd term based on copper loss. Effectiveness etaD of the conventional drive method which carried out direct continuation of the revolving shaft of a brush loess direct-current motor to the wheel in the electric vehicle of an in wheel motor drive method transforms (1) type, and is expressed with a degree type (2).

etaD=1/(1+AT/nN+Bn0.6 N/T) (2)

N is the number of driving wheels here.

[0012] In this example, effectiveness etaH of a drive system multiplies a sun gear, planetary gear 23 and 23, --, effectiveness etaG of the moderation device which consists of ring wheel 24 grade by effectiveness etaB of a brush loess direct-current motor, and it is a degree type (3).

etaH=etaG/{1+AT / (nNi2) +B(ni) 0.6Ns /, and (i/T)} (3)

It is come out and given. i is gear ratio here. Generally effectiveness etaG of a moderation device becomes a value quite near 1. The iron loss of a motor is [in / in that especially the motor of an electric vehicle is in an acceleration condition **** / low-speed transit of about 40km/h] quite smaller than copper loss. Therefore, (2), effectiveness etaD in (3) types, and etaH have main copper loss. When the copper loss of (2) and (3) types is compared (i.e., if the copper loss of the conventional drive method is compared with the copper loss of this example), the copper loss of this example is small by the square of gear ratio i. several [therefore, / several / of a driving wheel / the constant A of winding resistance and the motor depending on a torque constant, and] -- if N is the same, the copper loss of this example will serve as 1-/i2 of the copper loss of the conventional drive method. Moreover, if it is made to become the same copper loss in (2) and (3) types, the constant A of the motor depending on the winding resistance and the torque constant of (3) types or a driving wheel is small several Ns, and it can carry out. This shows that it is possible to make small size of a brush loess direct-current motor or to reduce several Ns of a driving wheel. That is, according to this example, it means that size of a brush loess direct-current motor can be made small as compared with the conventional drive method, or several Ns of a driving wheel can be reduced.

[0013] The electric vehicle corresponding to (2) types and the electric vehicle of this example corresponding to (3) types are examined as a now concrete example. Both the motors carried in these electric vehicles shall be used as a brush loess direct-current motor, and the number of these motors, gear ratio, etc. shall be shown in Table 1, respectively. In Table 1, a motor (2) corresponds to (2) types, and a motor (3) corresponds to (3) types and it makes weight abbreviation identitas. Moreover, the motor carried in an electric vehicle is made [at the electric vehicle corresponding to (2) types] into two pieces in the electric vehicle of this example corresponding to four pieces and (3) types. Gear ratio of the electric vehicle of this example was set to 4.4.

Table 1 (property of a motor)

Motor (2) Motor (3)

A torque constant (Nm/A) 1.96 The armature resistance per 0.3822 1 phase (omega) 0.0675 0.0064 stray addition loss,1.15 1.15 no-load loss factor 0.00477 0.00121 controller loss-1 0.0156 0.0078 (it is proportional to the square of a current)
Controller loss-2 (it is proportional to a current) 9.02 At the time of the regeneration of 4.51 cells, internal resistance (omega) 1.112 At the time of discharge of 0.556 cells, internal resistance (omega) 0.864 0.432 maximum current (A) 212 480 cell voltage (V) 329 329 gear ratio 1 Transmission efficiency of 4.4 gears 1 0.95 motor number 4 2 [0014] Cell weight shall carry the motor of the above-mentioned conditions in the electric vehicle of 531kg and four-person riding. Moreover, as compared with the electric vehicle corresponding to (2) types in the AUW of a car body, only the part to which the AUW of the electric vehicle concerning this example decreased in the motor and the controller to two pieces from four pieces should become light. The example of the specification of each electric vehicle is shown in Table 2 under such conditions. In addition, in Table 2, a car (2) uses a motor (2) and a car (3) as the electric vehicle carrying a motor (3).
Table 2 (property of an electric vehicle) Car (2) Car (3)
A frontal projected area (m2) 1.83 A 1.83 air-resistance multiplier 0.25 0.25 coefficients of rolling friction 0.0072 0.0072 rotation sections phase-splitting this weight 1.03 A 1.025 tire diameter (m) 0.633 0.633 AUW (kg) Energy density of 16601560 cells (Wh/kg) 56.7 56.7 cell weight 531.2 (kg) Class of 531.2 cells NiCd NiCd [0015] Based on the specification of Table 2, the mileage per 1 charge of each electric vehicle, the acceleration engine performance, full speed, etc. are calculated, and it is shown in the next table 3.
Table 3 (engine performance of an electric vehicle)
Car (2) Car (3)
1 charge mileage at the time of 40 km/h fixed-speed transit 557km 566km 1 charge mileage at the time of 100 km/h fixed-speed transit 272km 1 charge mileage at the time of 264km4 mode-pattern ****** 232km 1 charge mileage at the time of 349km10 mode-pattern ****** 198km 306km The acceleration time to 0 to 50 km/h 4.65s The time amount which 0 to 400m transit takes for 4.75s 17.9s 17.4s full speed Although there is no difference between both cars (2) and (3) exceptionally in the mileage per 1 charge, at the time of fixed-speed transit, it is understood that a big difference appears in the engine performance in pattern transit, so that clearly from the 166 km/h188 km/h above-mentioned table 3. Especially the reason is because the effectiveness of the drive method of this example is large on condition that the acceleration which the magnitude of copper loss affects, and regeneration. Moreover, as compared with the method which links the conventional brush loess direct-current motor with a wheel directly, there is economical effectiveness that the number of motors can be reduced.
[0016]
[Effect of the Invention] As mentioned above, since the moderation device in which a wheel is driven consists of a sun gear attached in the revolving shaft of an electric motor, planetary gear to which it gears with this sun gear, and a ring wheel with which these planetary gear gear according to invention according to claim 1, it is possible to raise the effectiveness of a driving gear and the number of motors for a drive can be reduced as compared with the conventional method. Moreover, a lightweight motor is also applicable. Furthermore, since the hub of a wheel is directly linked with the body of revolution for brakes while being combined with the mechanical body of revolution for brakes, the output shaft of planetary gear is easy structure, is lightweight, and has consumption of electrical energy, and the advantage with which it is few and ends. According to invention according to claim 2, in addition to the above-mentioned effectiveness, since an electric motor is an inner rotor mold, the effectiveness which can make copper loss small by the same weight as compared with the electric motor of an outer rotor mold is acquired. Furthermore, according to invention according to claim 3, quiescence members, such as an anchor pin of a brake shoe, or the caliper body of a disk brake Since the armature of an electric motor is connected to the outer frame currently fixed to the car body, according to invention according to claim 3, the outer frame of the armature of an electric motor Since it is attached in the suspension arm through the swivel joint, the advantage with which the structure of the whole driving gear is easy and it can lightweight-ize, therefore there is little consumption of electrical energy and it can be managed is acquired.

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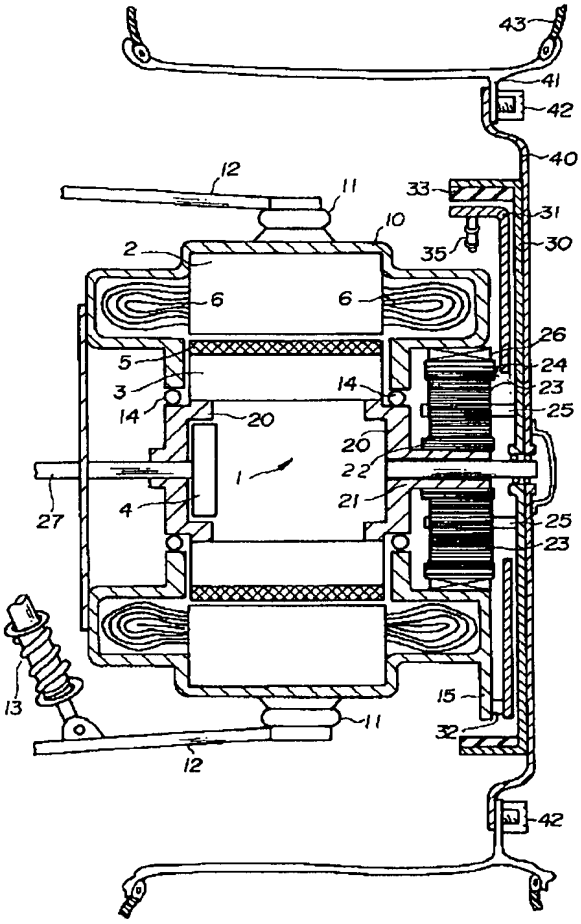
DRAWINGS

[Drawing 1]



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